Industry Sector Analysis

Photovoltaic Power Generation

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Summary

The Japanese photovoltaic power generation market is rapidly expanding with the support of the Government of Japan's financial support policies plus domestic utilities' new policy of purchasing electricity at rates equal to their residential selling prices. In compliance with Japan's commitment to the COP3 conference in Kyoto in 1997, the revised long-term supply and demand forecast was announced in 1998 by the Ministry of International Trade and Industry (MITI). This forecast aimed at introducing 5,000 MW of photovoltaic power by 2010. This is more than 50 times as much as the level in 1997. To cope with this lofty target, Japanese manufacturers have been rapidly expanding their production capacity resulting in substantially reduced cost. The Government of Japan expects photovoltaic power generation costs by the early 2000's be reduced to approximately 24 yen per kWh, which is equal to the selling price of residential electricity by the electric utilities. The current photovoltaic power market, estimated at approximately $1,200 million annually, is expected to grow sharply toward more than $4,600 million by 2010.

Although the current import ratio is less than 10 percent of the total domestic market, post believes that there will be good opportunities for qualified U.S. firms in the rapidly growing photovoltaic power market.

Market Overview

An average individual residence annually consumes 4,490 kWh. A 4kW photovoltaic power generation system (PPGS) annually generates power from 3,200 kWh to 4,800 kWh. Power generation efficiency is as low as 10 to 15 percent, compared to 35 to 40 percent in the case of thermal power generation. Installation cost for 4kW PPGS is approximately 4-million yen. The service life for a PPGS system is 15 to 20 years.

The revised long-term supply and demand forecast of primary energy for Japan was published by the MITI in 1998 setting a target to comply with Japan's commitment to the COP3 conference held in Kyoto in 1997. Japan is committed to lowering greenhouse effect gas emissions six percent (from 1990 levels) by 2010. The revised forecast expects to increase the ratio of new energy in the total primary energy supply from 1.1 percent in FY 1996 to 3.1 percent in FY 2010, together with an increase of nuclear power from 12.3 percent to 17.4 percent and natural gas from 11.4 percent to 13.0 percent. According to the forecast, photovoltaic power generation is expected to increase from 91 MW in 1997 to 5,000 MW in 2010 on an installed capacity basis.

New photovoltaic power generation capacity added in 1999 was 77 MW and is expected to be 190 MW in 2000. The photovoltaic power generation market is estimated to be approximately $700 million in 1999 (at yen 114/$) and $1,200 million in 2000 (at yen 107/$).

The serious nuclear accident that took place at JCO's uranium-fuel processing plant on September 30, 1999 has caused suspension or cancellation of some of new nuclear construction projects. Although 16 to 20 nuclear reactor construction projects had been planned for completion by 2010, in compliance with COP3, only 13 nuclear reactors have been announced by the utilities for completion by 2010.

Market Trends

Photovoltaic power has considerable potential as an alternative to oil-based energy.
There are a number of merits for promoting photovoltaic power generation, these are:

- Power generation is possible whenever/wherever sunlight is available.
- Reduced limitations on site selection due to low noise and no emission of CO2 gas during power generation.
- Can easily be introduced to public living environments, such as civic buildings and individual residences.
- Almost no maintenance work is required.
- Although current installation costs are substantially high when compared with thermal power generation costs, the solar power market can thrive in the future by reducing production costs.

The introduction of photovoltaic power generation systems (PPGS) have gradually increased since 1992, when a system was introduced by which electric power utilities could procure PPGS electricity at prices equal to their wholesale sales price.

In 1994, the Ministry of International Trade and Industry (MITII) launched a program for residential PPGS that provides subsidies through the New Energy Foundation (NEF - - a non-profit organization under the jurisdiction of MITI), that covers approximately 50 percent of the investment cost for PPGS by selected individuals. This is done by lottery under the guise of "monitor projects" taking the form of joint research between the Japanese government and selected participants. The items covered by the subsidy are PV modules, peripheral equipment, distribution lines and installation work. This continued for three years until FY 1996 and contributed to expanding the Japanese PPGS market by substantially reducing installation costs.

The budgets for the subsidies were as follows:
FY 1994: 2.0 billion yen
FY 1995: 3.3 billion yen
FY 1996: 4.0 billion yen
Since FY 1997, the joint research system was transformed into a subsidy system using the moniker: "PPGS infrastructure development projects for residential use". The subsidy covers approximately 1/3 of PPGS installation costs. The budget

for the subsidies follows:

FY 1997 11.1 billion yen
FY 1998: 14.7 billion yen
FY 1999: 16.0 billion yen
FY 2000: 14.5 billion yen

In addition, the following subsidies were budgeted for “field test projects” to cover half of PPGS installation costs:
(for schools or other public buildings):
FY 1992: 850 million yen
FY 1993: 1,220 million yen
FY 1994: 1,030 million yen
FY 1995: 1,700 million yen
FY 1996: 1,900 million yen
FY 1997: 1,350 million yen

(For introduction of PPGS in industrial areas such as idle factory space)
FY 1998: 2,400 million yen
FY 1999: 2,410 million yen

There are also additional subsidy programs provided by some municipal governments.

Power generation costs by PPGS are still an issue to be solved. Current power generation costs are approximately 2.5 times as high as electricity tariffs imposed on residential usage. However, the power generation costs by PPGS have been sharply reduced in accordance with production expansion. According to MITI, the installation costs of PPGS for residential use and its power generation costs were (and are) expected to be as follows:

	FY1993	FY1998	Early 2000s(target)
PPGS cost (yen/kW)	3,660,000	1,000,000	480,000
Power cost (yen/kWh)	256	70	24

PPGSs for individual residences are generally three to four kW in size. Through innovation and increased in production efficiency, photovoltaic cell costs have been reduced to 1/50th since development started in 1974. The cost is expected to be reduced further in the future. The Government of Japan hopes to reduce the solar power generation cost to a level equal to the tariff currently set by the utilities for an individual residence that is approximately yen 24 per kWh.

The accumulated results of PPGS introduced in Japan and targets for introduction in the future follow:

FY 1991: 10 MW
FY 1992: 15 MW
FY 1993: 20 MW
FY 1994: 27 MW
FY 1995: 39 MW
FY 1996: 55 MW
FY 1997: 91 MW
FY 1998: 33 MW
FY 1999: 210 MW
FY 2000: 340 MW (forecast)
FY 2010: 5,000 MW (target)

(The target of 5,000 MW for FY 2010 consists of 4,200 MW for residential use, with 1,000,000 housing units and 800 MW for public building use with 40,000 points.)

Import Market

The results of domestic production, import and export of cells, and modules are as follows (unit: 1,000 kW):

January 1, 1998 - December 31, 1998	
Domestic production:	38.0
Import:	4.1
Domestic delivery:	42.1
Export:	11.0

January 1, 1999 - December 31, 1999	
Domestic production:	68.0
Import:	5.8
Domestic delivery:	73.9
Export:	11.7

Although imports increased from 4.1 MW in 1998 to 5.8 MW in 1999, the import ratio is down from 9.7 percent in 1998 to 7.8 percent in 1999. Major overseas supply sources and their importers are as follows:

Overseas suppliers (countries)	Importers
Siemens Solar Industries (U.S.)	Showa Shell K.K.
BP Solarex (U.S.)	MSK Corporation
BP Solar (U.K., Australia, Spain)	MSK Corporation
Solec International (U.S.)	Sanyo Electric
ASE (Germany, U.S.)	Kobe Steel
AstroPower (U.S.)	Japan Storage Battery Co., Ltd.
Evergreen Solar Inc. (U.S.)	Kawasaki Heavy Industries

Competition

According to PV News published in February 1999, statistics and share of photovoltaic cell production in the world in 1997, 1998 and 1999 follow (unit: MW):

In 1997	
USA:	51.0 (40.5 percent)
Europe:	30.4 (24.2 percent)
Japan:	35.00 (27.8 percent)
Others:	9.4 (7.5 percent)
Total:	125.8 (100 percent)

In 1998	
USA:	53.7 (35.1 percent)
Europe:	31.8 (20.8 percent)
Japan:	49.00 (32.0 percent)
Others:	18.70 (12.2 percent)
Total:	153.2 (100 percent)

In 1999:	
USA:	60.8 (30.8 percent)
Europe:	36.4 (18.4 percent)
Japan:	80.0 (40.5 percent)
Others:	20.5 (10.4 percent)
Total:	197.7 (100 percent)

Japan exceeded the U.S. and ranked the number one producer in the world taking more than 40 percent of world market share. Top three manufacturers in Japan are Kyocera Corporation, Sharp Corporation and Sanyo Electric Co., Ltd., followed by Mitsubishi Electric Corporation. With Japanese market share in the world rapidly expanding, the competition in the domestic market has become increasingly harsh.

According to the statistics prepared by Kyocera, major producers ' 1999 production shares follow with the global production being 202.2 MW:

BP Solarex (U.S.):	16.07 percent
Kyocera (Japan):	14.99 percent
Sharp (Japan):	14.84 percent
Siemens (Germany):	10.98 percent
Sanyo (Japan):	6.43 percent
AstroPower (U.S.):	5.93 percent
Photowatt (France):	4.95 percent
Others:	25.82 percent

End Users

The usage of PPGS is divided into two categories in accordance with the scale of power generation. PPGS with a capacity of 10 kW or less are classified as residential use. PPGS with capacity more than 10 kW are classified for public building use. Currently, residential use covers approximately 75 percent and with the remaining 25 percent covered by public building use. End users of PPGS include residential use and governmental agencies and corporations, public and industrial building owners for public building use.

According to NEF, qualifications for application of subsidies follow:

- Individuals planning to install a PPGS in their houses and execute an electricity sales/purchase contract for less than 10kW with local utilities. They must be able to commence construction within two months after confirmation from NEF.
- Home builders planning to install a PPGS to their ready-built houses and able to complete installation work by a certain date fixed by NEF. They must apply for the subsidy on behalf of individuals who will purchase houses with PPGS included.
- Municipal governments that collectively apply for the subsidy on behalf of individuals who wish to install a PPGS, based on PPGS promotion projects conducted by municipal governments.

Sales Prospects

A PPGS consists of photovoltaic modules, a support structure, a distribution panel, and a power conditioner that includes a utility interface and an inverter. AC switchgear and a watt/hour meter for receiving and sending power are also needed. Most of the imported materials consist of solar cells and modules.

Market Access

Regarding cells and modules, there are no import barriers. No import tax is imposed. There are no restrictions on imported cells and modules in applying for subsidies as long as they are approved by Underwriters Laboratories (UL). Regarding inverters, which are necessary for converting direct current generated into alternating current, these are required to receive an approval test by the Japan Electrical Manufacturers' Association (JEMA), based on the standards set by MITI. As this process requires substantial time and money, domestic inverters are being used.

Most imported materials consist of solar cells and modules. Importers of cells and modules sell them directly to local homebuilders or through wholesalers. There are primary and secondary wholesalers. The wholesalers sell them to roofing contractors and electrical construction companies.

Key Contacts

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Japan Photovoltaic Energy Association (JPEA)
(A private organization established to promote photovoltaic power generation whose members consist of public organizations, manufacturers of cells and modules, manufacturers of components and materials for cells and modules, electric power and gas utilities and general contractors and house builders.)

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Upcoming Trade Shows

U.S. Eco-Energy 2000
- Organizer: The Commercial Service Tokyo
- Period: October 12-13, 2000
- Place: U.S. Trade Center at Ikebukuro, Tokyo
- Content: Exhibition and seminar on U.S. technologies for alternative and renewable energy

ISA Customer Satisfaction Survey

U.S. Department of Commerce
* International Trade Administration*
The Commercial Service

The U.S. Department of Commerce would appreciate input from U.S. businesses that have used this ISA report in conducting export market research. Please take a few moments to complete the attached survey and fax it to 202/482-0973, mail it to QAS, Rm. 2002, U.S. Department of Commerce, Washington, D.C. 20230, or Email: Internet[Opfer@doc.gov].

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* * * About Our Service * * *

1. Country covered by report: _____
Commerce domestic office that assisted you (if applicable):
_____

2. How did you find out about the ISA service?
__Direct mail
__Recommended by another firm
__Recommended by Commerce staff
__Trade press
__State/private newsletter
__Department of Commerce newsletter
__Other (specify): _____

3. Please indicate the extent to which your objectives were satisfied:
1-Very satisfied 2-Satisfied
3-Neither satisfied nor dissatisfied
4-Dissatisfied 5-Very dissatisfied
6-Not applicable

__Overall objectives
__Accuracy of information
__Completeness of information
__Clarity of information
__Relevance of information
__Delivery when promised
__Follow-up by Commerce representative

4. In your opinion, did using the ISA service facilitate any of the following?
__Decided to enter or increase presence in market
__Developed an export marketing plan
__Added to knowledge of country/industry
__Corroborated market data from other sources
__Decided to bypass or reduce presence in market
__Other (specify): _____

5. How likely would you be to use the ISA service again?
__Definitely would
__Probably would
__Unsure
__Probably would not
__Definitely would not

6. Comments:

_____

* * * About Your Firm * * *

1. Number of employees: __1-99 __100-249 __250-499
__500-999 __1,000+

2. Location (abbreviation of your state only):_____

3. Business activity (check one):
__Manufacturing
__Service
__Agent, broker, manufacturer's representative
__Export management or trading company
__Other (specify):_____

4. Export shipments over the past 12 months:
__0-1 __2-12 __13-50 __51-99 __100+

May we call you about your experience with the ISA service?
Company name: _____
Contact name: _____
Phone: _____

Thank you--we value your input!

Washington, D.C. 20503.

FORM ITA 4130P-I (rev. 5/95)
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